27th Technical Convention 2019

The 4th Industrial Revolution ("4IR") | *Building the Power Utility of the Future, Today*

Making Smart Grids smart, makes Smart Cities smarter

Presented by Martin Kuhlmann
Technical Sales – Smart Metering
Siemens (Pty) Ltd
SI DG S

Hosted by CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD

Global megatrends are changing our markets – structurally and profoundly

Quantifying megatrends that are changing our world

By 2050, nearly **70%** of the world population will live in cities; today it's **54%**.

Source: United Nations, World Urbanization Prospects. The 2014 Revision, New York, veröffentlicht 2015

At the UN Climate Conference in Paris in 2015, almost all nations of the world agreed to limit anthropogenic global warming to well under **2º centigrade**.

Source: Earth System Research Laboratory, NOAA, 5. Oktober, 2017

By 2020, the global volume of data will soar to **44 zettabytes**, and **50 billion** devices will be connected.

Source: IDC, The Digital Universe of Opportunities: Rich Data and the Increasing Value of the Internet of Things, April 2014

In the time span of **20 years**, global export volume has more than quadrupled.

Source: Statista, 2017


10 billion
people by 2050

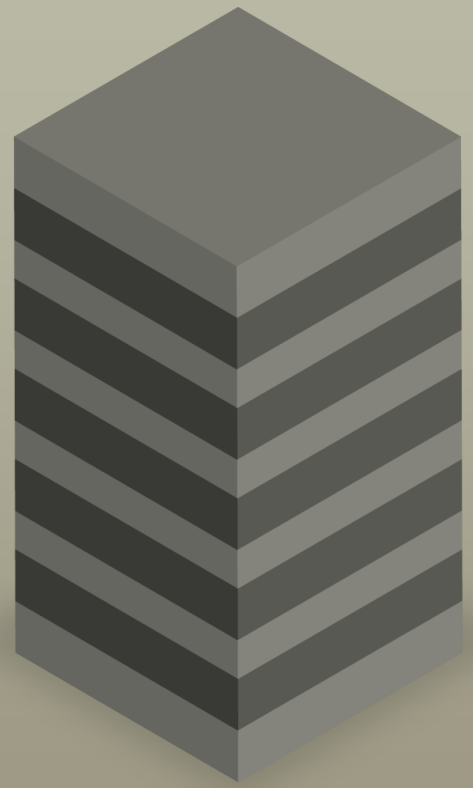

70% in cities

The future of energy systems, buildings and industries

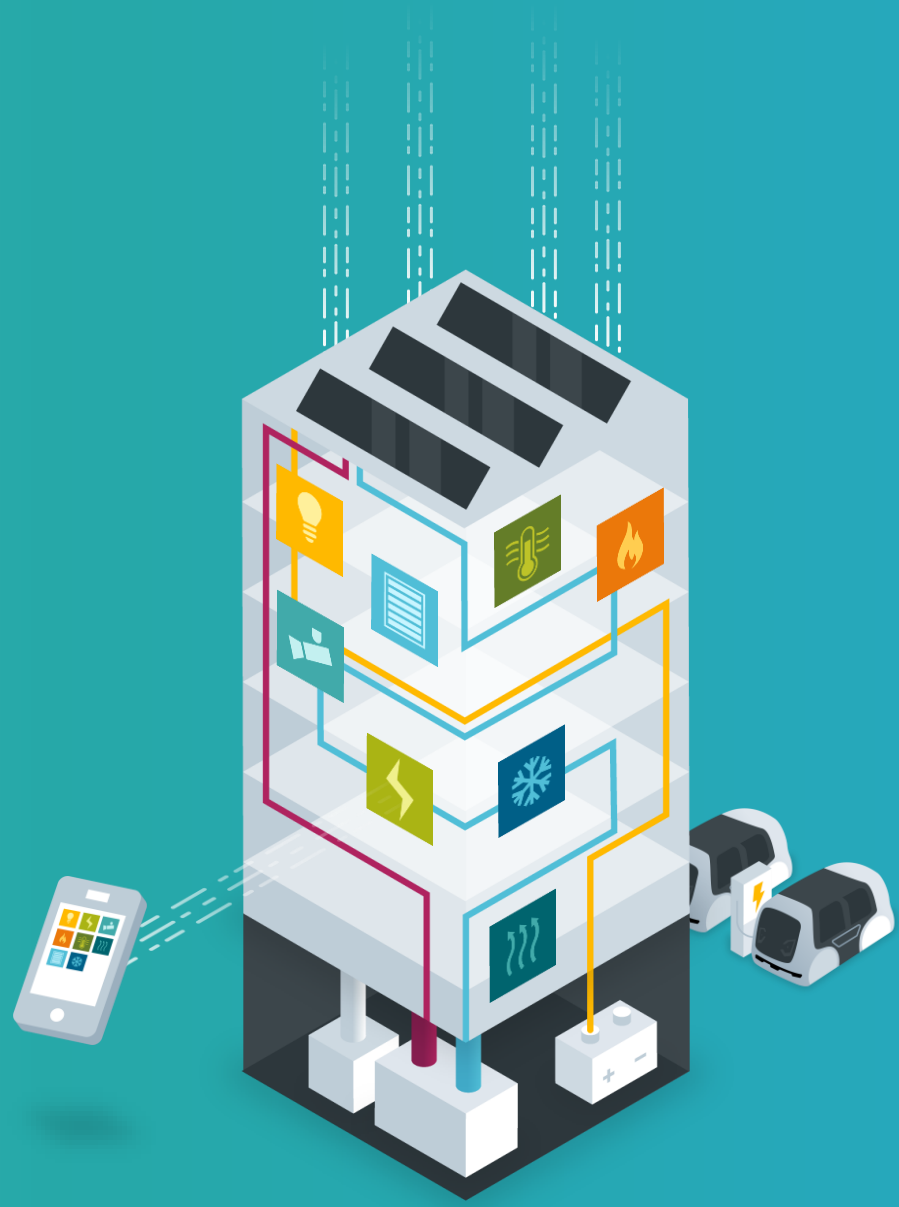
The energy system back in the day

The energy system today

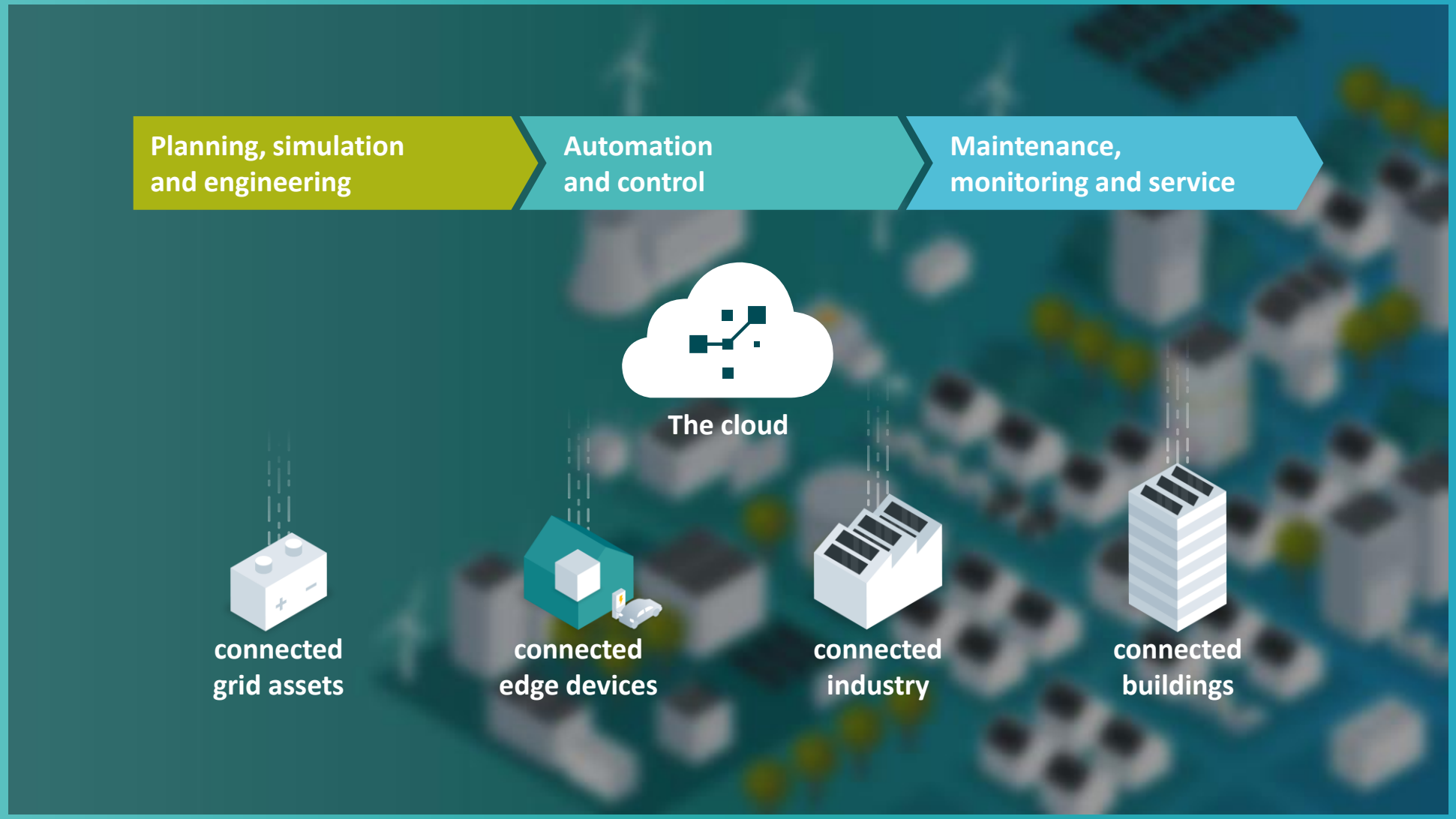
Buildings back in the day



Buildings today



Buildings are becoming an active part of the energy system


Planning, simulation and engineering
Automation and control
Maintenance, monitoring and service
The cloud
connected grid assets
connected edge devices
connected industry
connected buildings

Smart Infrastructure

Why –
smart infrastructure

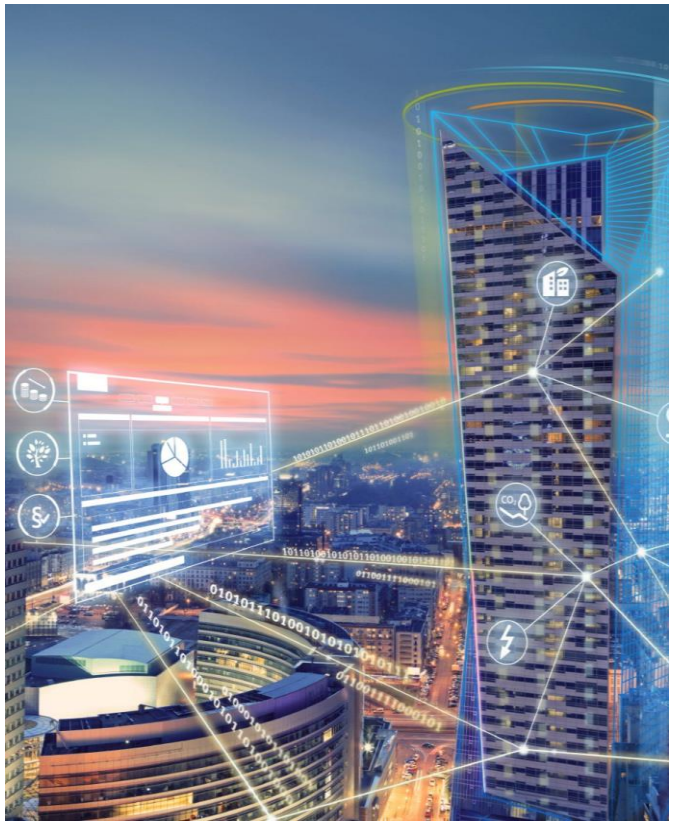
Creating environments that care

- Making real what matters: Humans care. We want an urban, sustainable, livable world that optimally combines real and digital solutions.
- We address infrastructure challenges, contributing to sustainable development and creating the best possible environments in which to live and work.
- With smart infrastructure, we intelligently connect energy systems, buildings and industries to adapt and evolve the way we live and work. We create an ecosystem that intuitively responds to the needs of people and helps us to better use resources. It helps our customers to thrive and communities to progress.


Ultimately, we protect
the next generation

Creating environments that care

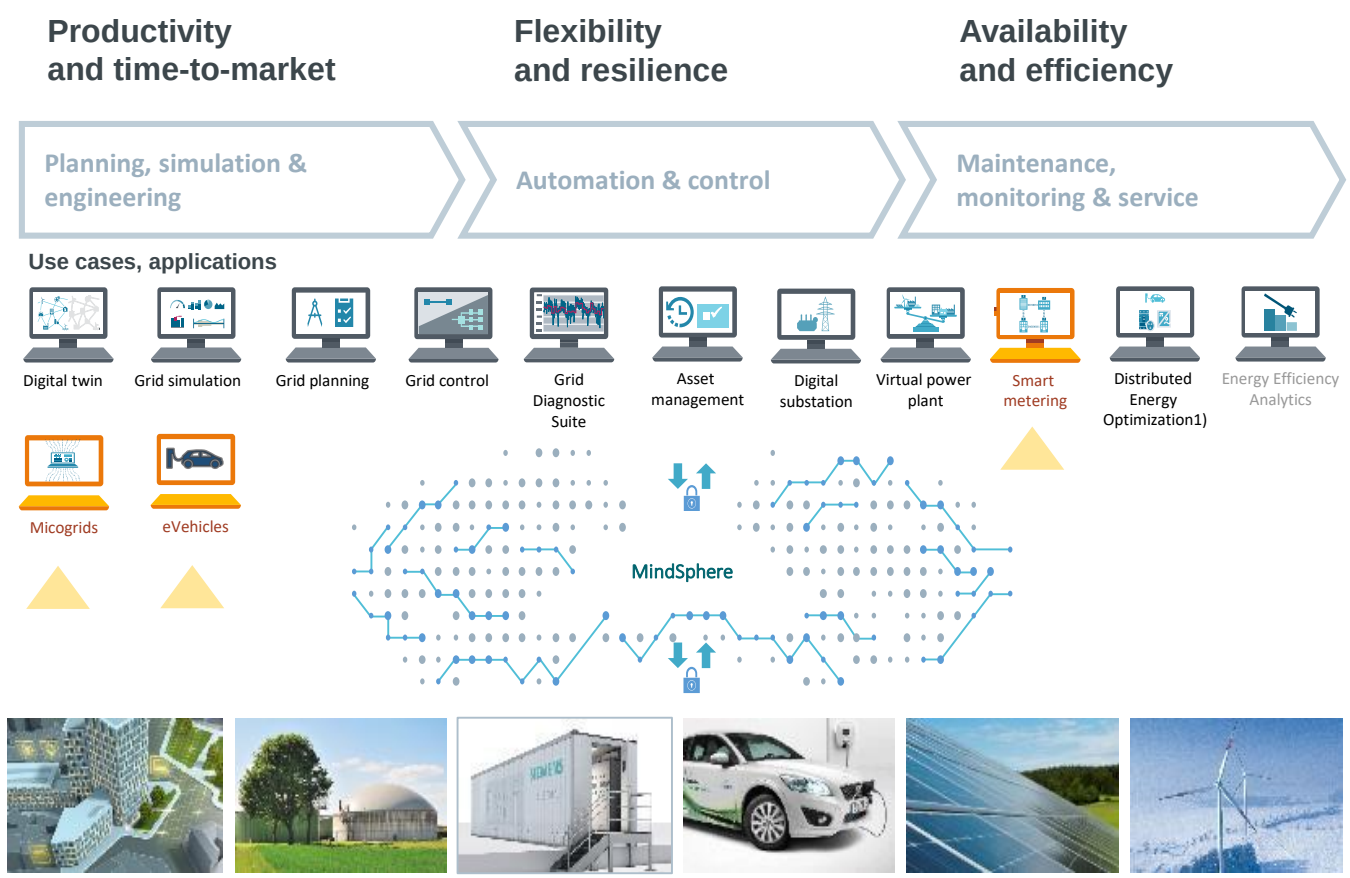
What –
smart infrastructure



Smart grids + smart buildings = smart infrastructure (and Smart Cities)

- Smart Infrastructure brings together energy systems – from the intelligent control across the grid to medium-voltage distribution system, through a broad range of low-voltage and control products, to the point of consumption – with the broad portfolio of building technology.
- At the point of connection between the grid and buildings – at the grid edge – there are exciting nascent markets including prosumption, meter data management systems, electric vehicle infrastructure, energy storage, microgrids etc.
- Smart Infrastructure combines physical solutions and digitalization across the focus areas of electrification and automation.

Driving the next level of digitalization for secure, efficient and intelligent power



Key areas of digitalization

Digital twin

Virtual and real world combined

Connectivity / IoT

All power assets incl. digi-tal substation / automation

Edge devices like sensors, smart meters, storage, e-cars, inverters (PV), …

Cyber security

1) DER: Distributed energy resources like smart meters, inverters for photovoltaics, e-mobility assets, storage systems, microgrids, …

Smart Grids in Smart Cities

Smart grids => Smart Cities

Smart Grid is the effective digitisation of field assets and respective communication of an Electrical Grid and Water Infrastructure into a central digital management system that:

- Manages Grid control systems such as Protection devices with SCADA
- Manages load / consumption systems such as Power Quality Meters and Commercial Smart Meters with MDMS
- The integration of the above to effectively unify data

MDMS load data will enable a typical SCADA system to understand load profiles etc in a “Electrical Digital Twin” system so that unnecessary overloads can be avoided, as an example.

Smart Cities will use Smart Grid data to heighten operation management of the Smart City and provide feature rich data for Industrial Zones, Commercial Zones, Public and Consumer zones etc

Unified reporting and operation dashboard display of data in a “Smart City” will enable effective management and efficiencies, as well as encourage consumer behaviour and trust.

Smart Grids

Smart Grids

Smart Grid can be interpreted differently from one provider to the next. However, it is the effective combination of focussed areas in a typical grid as follows:

- Substation automation, protection, and smart communications
  - Substation Automation
  - Protection for digital substations
  - Optimization of power quality
  - Smart communication
- Grid operation and control
  - Microgrids
  - Distribution Automation
  - Digitalized substations

Smart Grids

Smart grids

- Grid applications and analytics
  - Grid Applications
  - Grid Analytics
  - Data Analytics
  - Grid Diagnostics
  - Cyber Security
  - Managed Services
- Grid planning and simulation
  - Power system consulting
  - Power system simulation and modelling
  - Electrical Digital Twin
- Grid Security

Smart Cities

Smart Cities

What makes a city smart?

Smart City solutions contribute to the effective management of urban areas, improving connectivity, sustainability, and liveability. Across all areas of city life, technology and data are used to analyse and optimise functionality and efficiency, thus enhancing outcomes and improve quality of life to those living in the City.

- Dimensions of smart city development
- Unlocking the Potential of Cities
- City Air Management
- Smart City Digital Hubs
- Urban Mobility Solutions
- Digital Logistics – Airports
- IoT Services
- City Performance Tools
- Creating resilient cities

Making Smart Grids smart, makes Smart Cities smarter

Smarter Cities

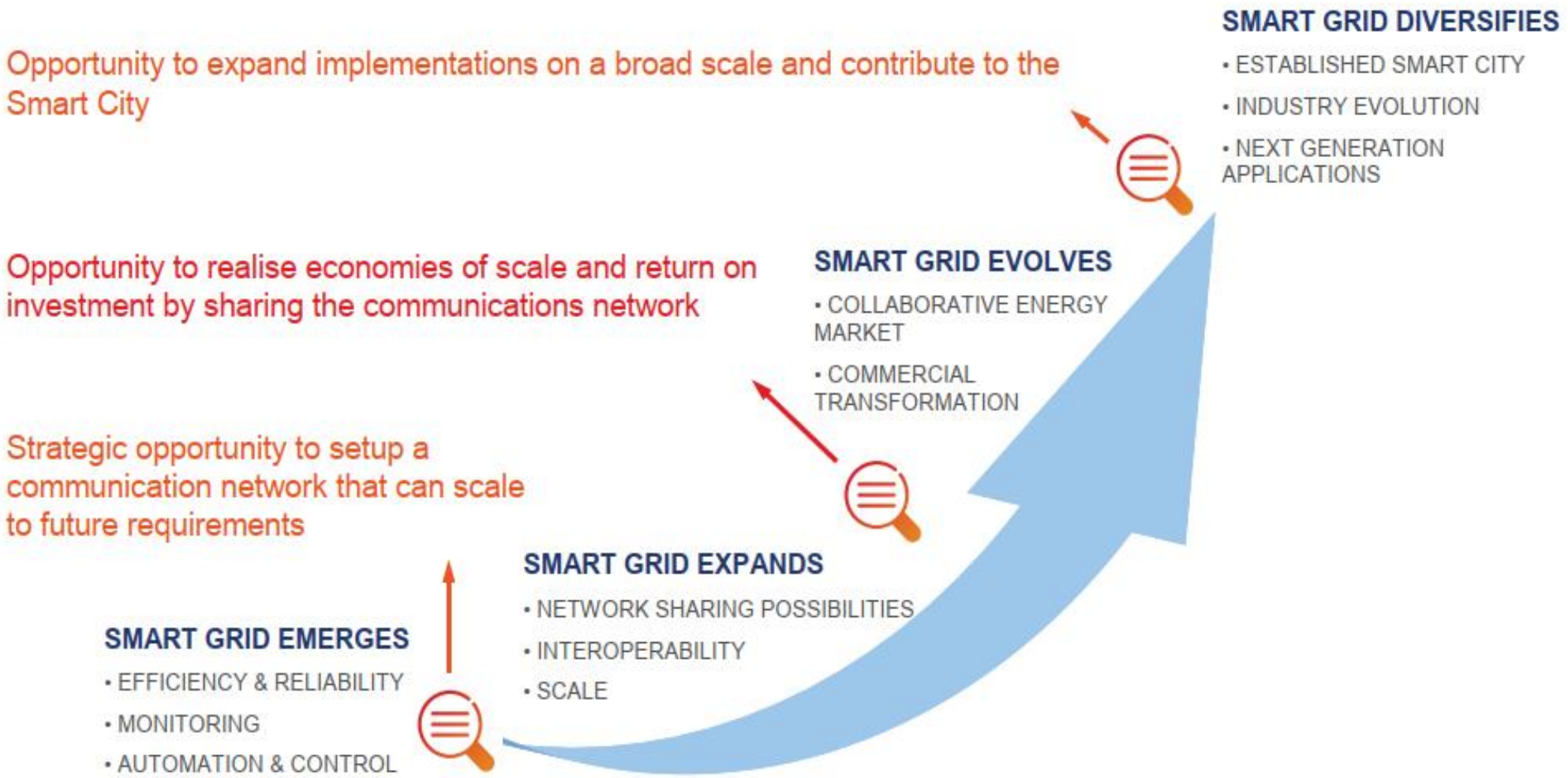
“Aren’t Smart Grids smart anyway”?

Smart Grids and Smart Cities are very similar and Smart Grids enhance Smart Cities.

A Smart Grid provides a direct and 100% proportion to the ‘smartness” of a Smart City. “To meet the goals of a smart city in supporting a sustainable high-quality lifestyle for citizens, a smart city needs a smart grid.

To build smart cities of the future, Information and Communications Technology infrastructure will be a key enabler, and strategic choices made by utilities today have the power to transform society tomorrow.”

Making Smart Grids smart, makes Smart Cities smarter



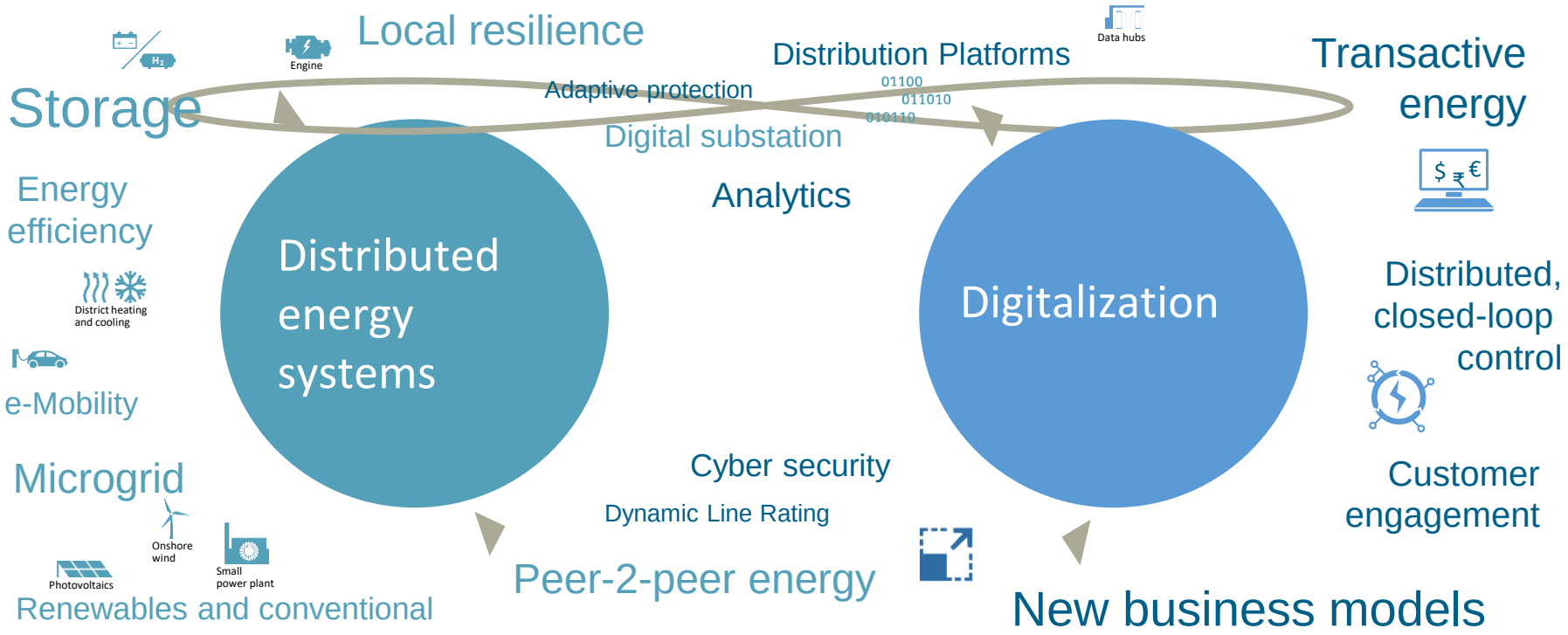
Making Smart Grids smart, makes Smart Cities smarter

Three Focus Areas + examples

- **Meter/IoT Data Management**
- **eMobility Charging Ecosystem**
- **Microgrids**
- **Smart Infrastructure examples – Smart solutions**

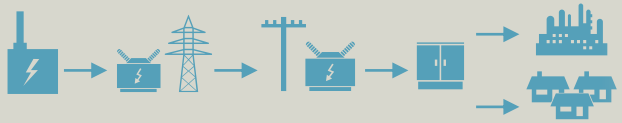
Meter/IoT Data Management

These two major trends are enforcing each other and are driving the transformation of the energy world



Digitalization enables energy transition

Traditional energy value chain



- Utilities focus on own assets and operation
- System view based on business model "generat distribute, and sell energy"
- Value in copper
- Customized, utility-specific “grid-size” solutions
- Manual operation
- Central generation, generation follows load

Digitalization enables transition

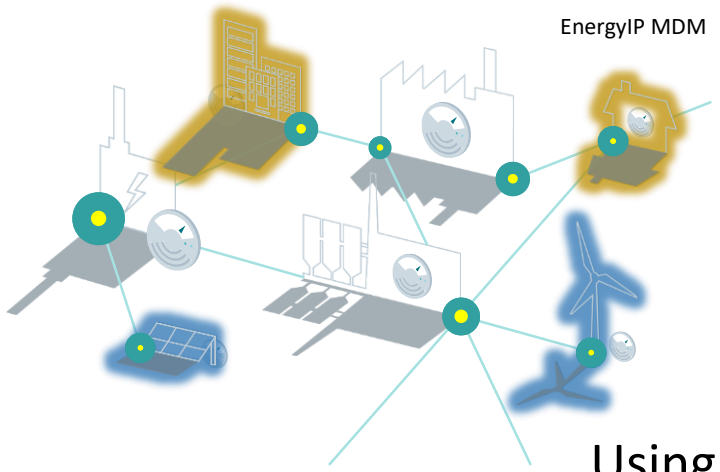
New distributed energy world

- Focus on customer assets, needs and requirements
- Local view, new customer-centric business models
- Value in SW and fast innovation
- Off-the-shelf, scalable solutions for many distributed sites
- Automated, highly efficient operation
- Distributed and renewable generation, flexible energy systems e.g. demand response

Data-driven Grid Operation is the backbone of smart infrastructure strategy

Managing Intelligent Devices

EnergyIP MDM



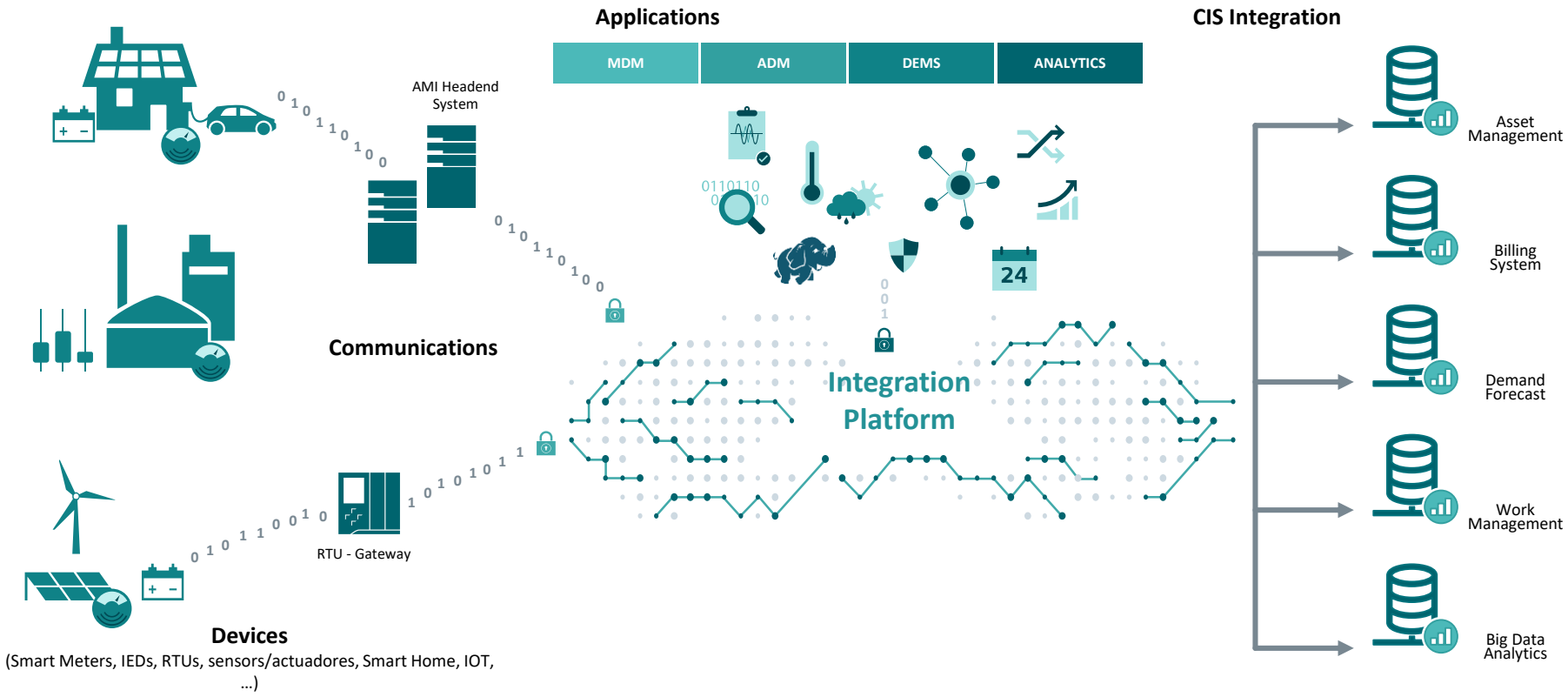
Managing Distributed Assets

EnergyIP DEMS

Using Data to improve Grid Operations

EnergyIP Analytics

MDMS Integration Platform



eMobility Charging Ecosystem

Multiple applications for charging

- **Scalable**
- **Flexible**
- **Reliable**
- **Sustainable**

… and these mega trends lead to fast implementation of E-Mobility

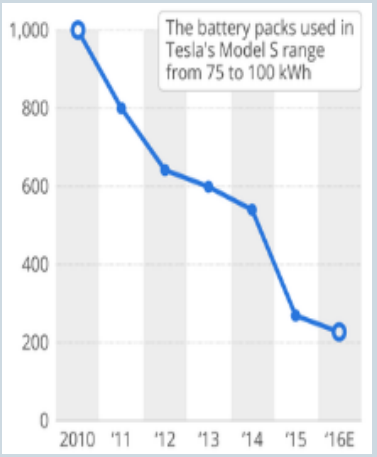
Drivers for e-Mobility adaption

Clean air Strategy:
NOx, CO_2 emission and noise reduction

Sector coupling:
Renewable integration

Integrated mobility concept:
Multi-modal transportation

Dropping prices for avg. battery packs:
$ / kWh

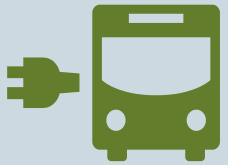


Source: McKinsey sustainable mobility initiative, Bloomberg new energy finance

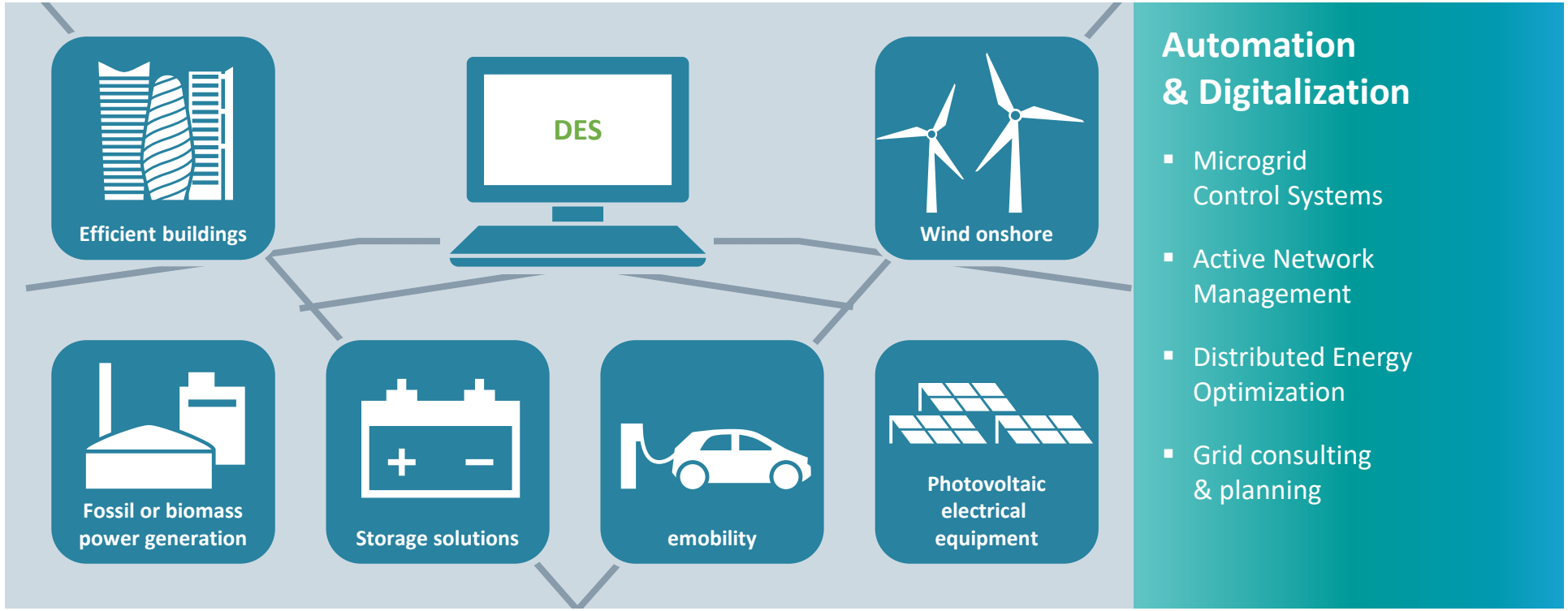
Attractiveness:
Declining acquisition costs & total cost of ownership, policy & regulatory advantages

Driving range:
Continuous increase of EV driving range

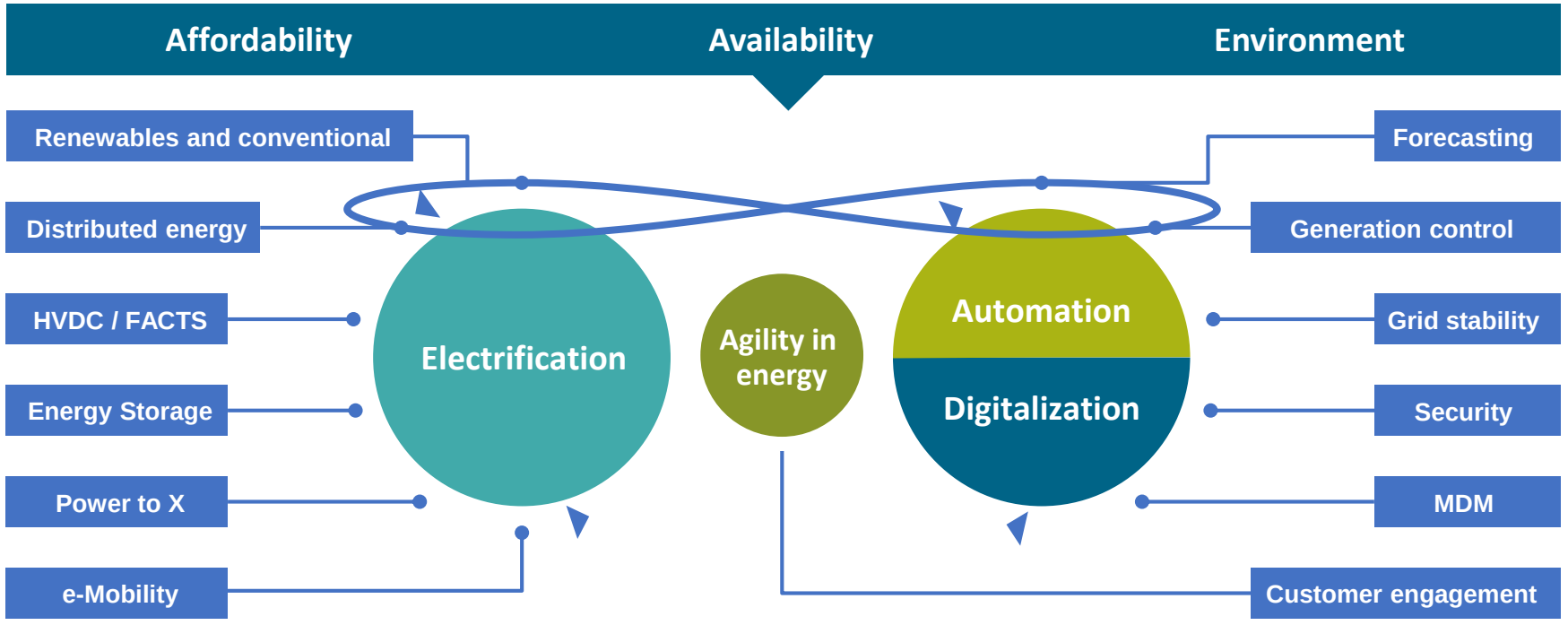
Infrastructure & applications:
Inf. deployment & smooth adaption (e-Bus, commercial)



E-Mobility is driven by DES and in particular Microgrid control for independence and over burdening use of the grid



Digitalization drives dramatic change in energy systems

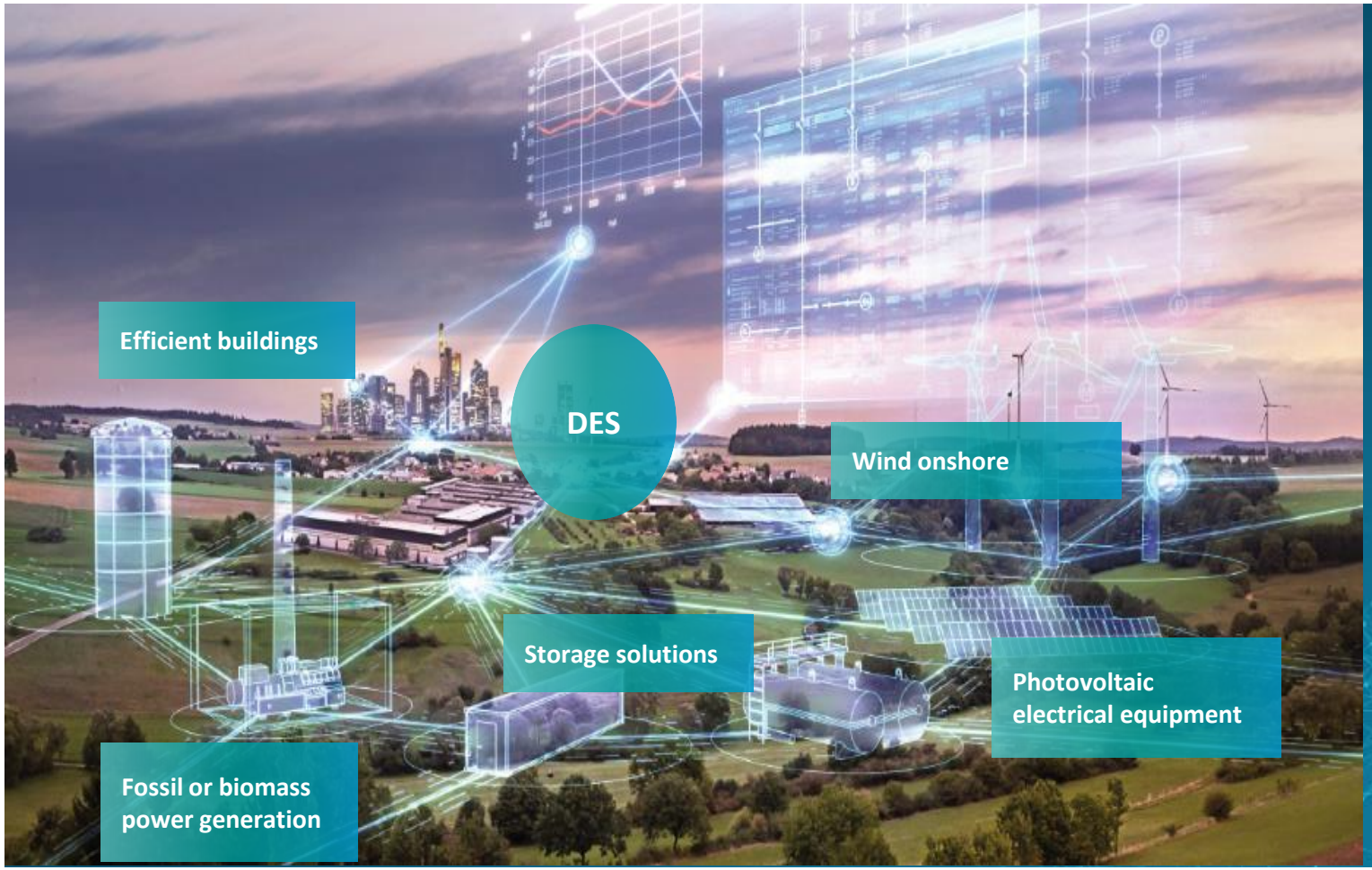


HVDC/FACTS = High Voltage Direct Current/Flexible AC Transmission Systems

MDM = Meter Data Management

Microgrids

Microgrid control and automation is at the heart of DES managing energy assets and maximizing the value of the solution

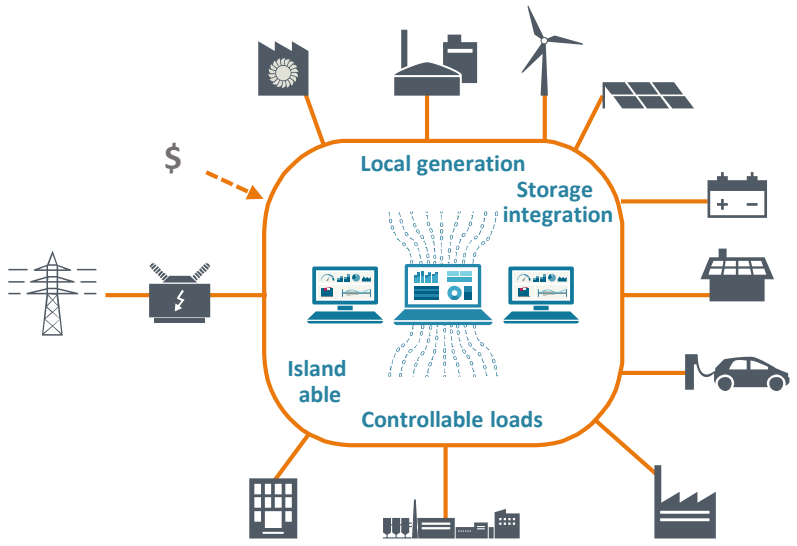


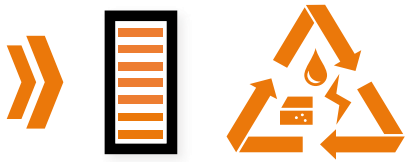
Automation & Digitalization

- Microgrid Control Systems
- Active Network Management
- Performance Analysis & Monitoring
- Grid consulting & planning

Customer landscape changing: Smart Cities require highly predictable, value driven, and service data based business models

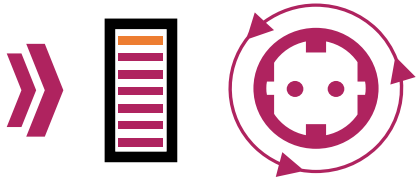
Decentralized Energy systems and Microgrids have 3 major value propositions to be quantified and monetized





Economic & Energy efficiency

- Capex vs Opex
- Distributed generator control
- Load / storage control



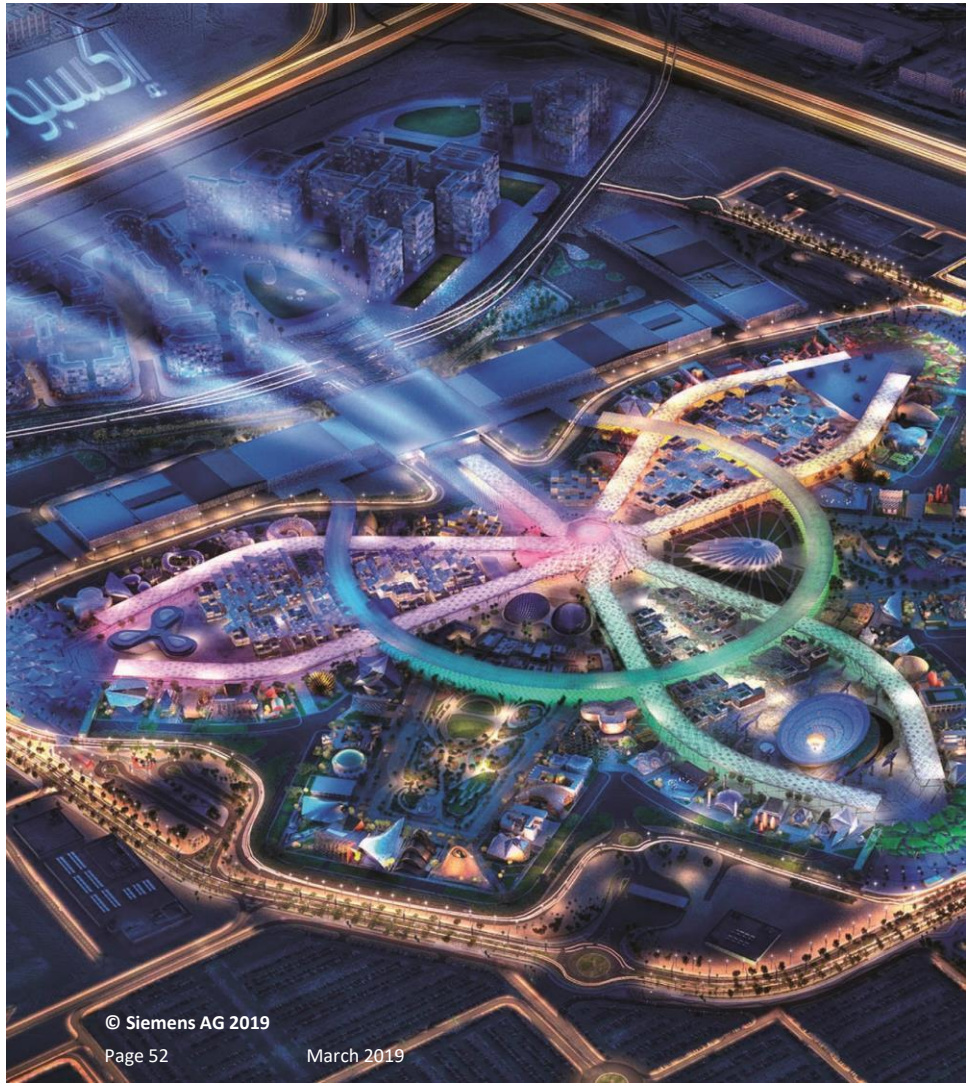
Reliability, resilience

- Black start
- Network synchronization
- Online Control via HMI / Grid Monitoring and Control
- Enhanced SCADA functionality

Sustainability

- Generation / load forecast
- Dynamic grid constraint consideration using state estimator function


Smart Infrastructure –
Smart Solutions



A blueprint for cities of the future – Expo 2020 Dubai

As Premier Partner for infrastructure digitalization, Siemens will help plan, build and operate the most connected, intelligent and digital World Expo in history.

At Expo 2020 Dubai, Siemens is creating a blueprint for digital cities based on our IoT operating system and domain know-how.

Benefits

- Digitalized infrastructure will support Expo 2020 Dubai in meeting sustainability targets
- 137 buildings will be connected via Navigator – the cloud-based energy and sustainability platform; one of the world's largest installations of Siemens
- Siemens will support Expo 2020 Dubai's legacy strategy with technology living on in District 2020 – the smart city planned at the site beyond Expo 2020 Dubai

Outstanding reduction of service cases – Anglian Water, UK

Municipal operator for water supply and wastewater treatment in London, serving 6 million households.

Pump cleaning function provided with SIMOCODE Motor Management.

Prevents water leakage and unscheduled manual work.

Benefits

- Number of on-site service cases reduced by 75%
- Impact of average cost per pump blockage is about €500
- 34,000 less blockages per year
- €17 million savings per year

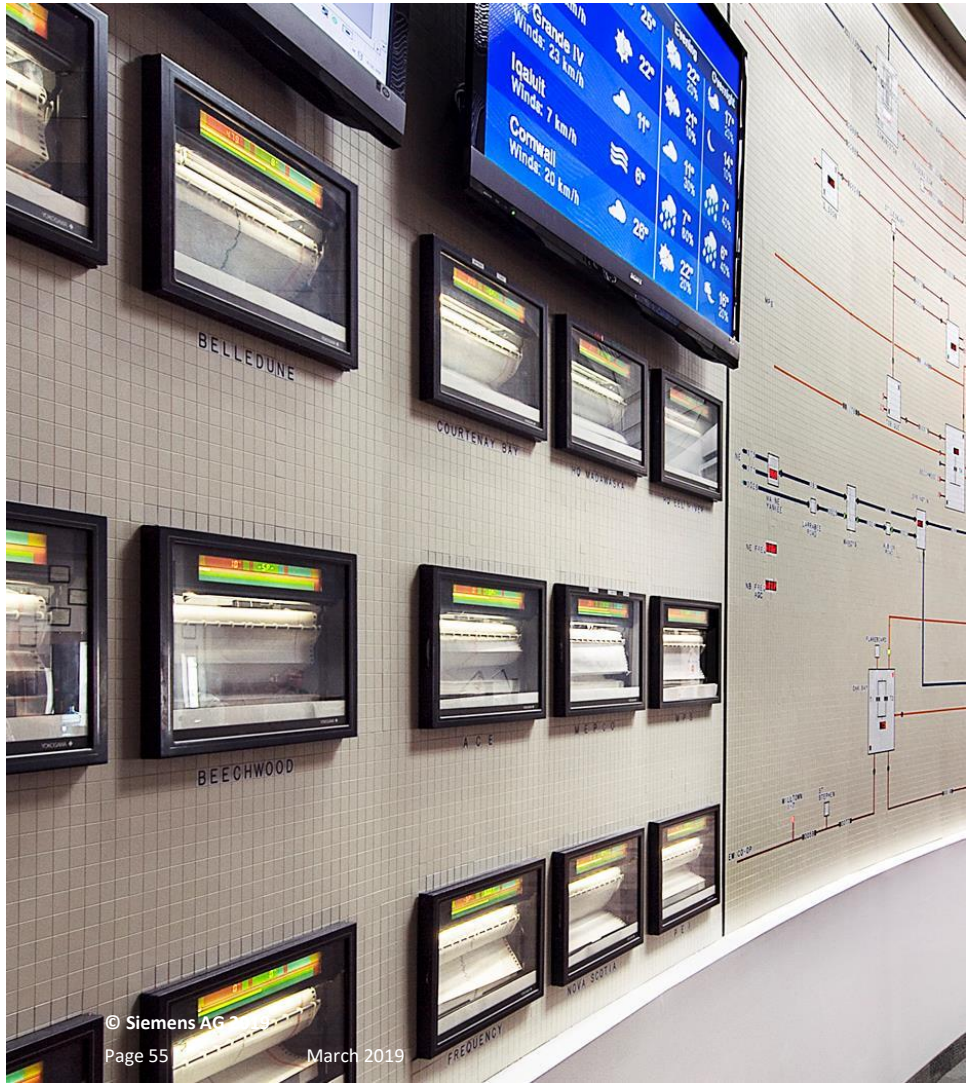
Building management and fault-proof power distribution – REN Data Center, Portugal

REN runs the largest data center in Portugal. Siemens contributes the entire power supply as well as building technology.

Siemens was picked due to offering the most innovative features together with flexibility and security.

Benefits

- Maximum safety and security against any possible threats
- Energy efficiency and modular power supply for highest reliability of the power distribution system (TIER III certification)
- Delivery of a turnkey solution right on time



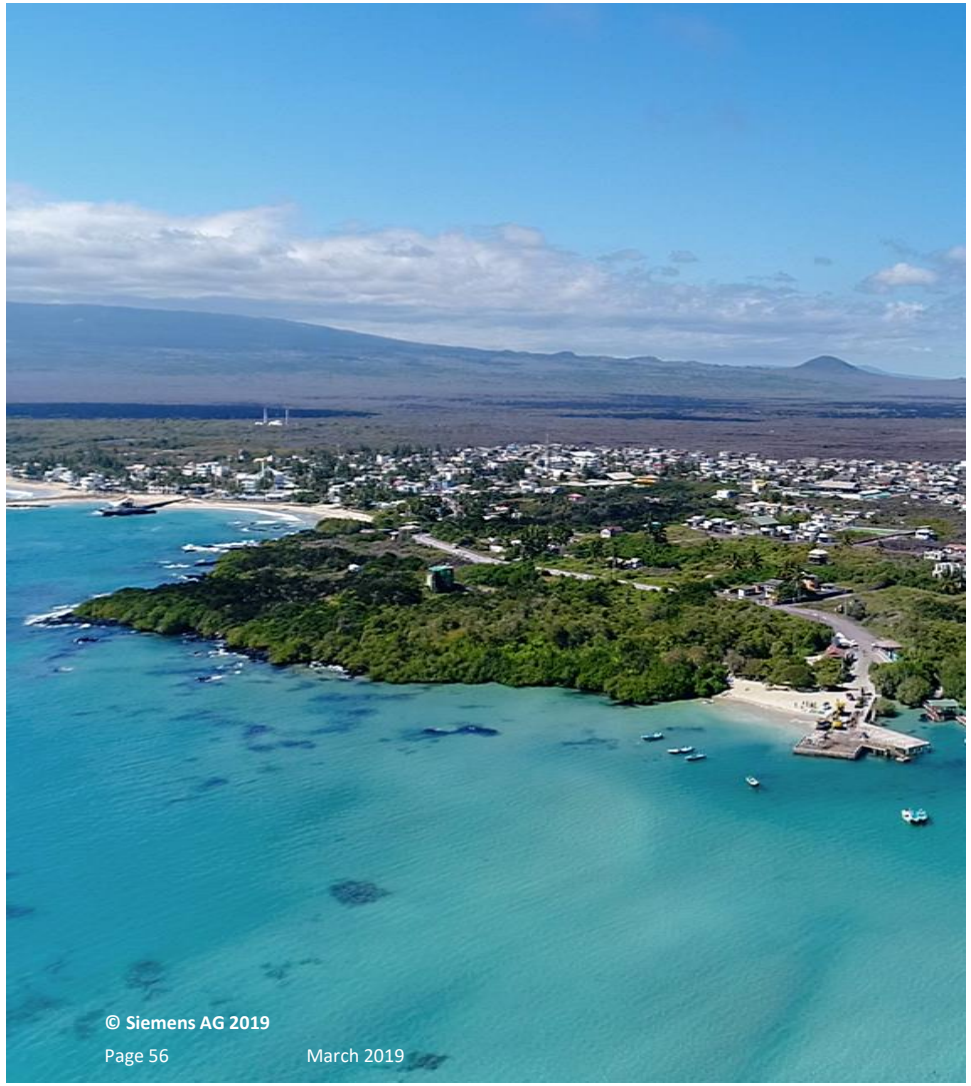
Demand management – NB Power, Canada

Integration of a holistic smart grid concept to supply more than 345,000 customers in the Canadian province of New Brunswick with electricity.

Solution: Decentralized generation and consumer load bundled on a virtual platform used as a flexible single power plant.

Benefits

- Optimization of investments
- New business model makes NB Power fit for the future
- Substantial CO_2 reduction



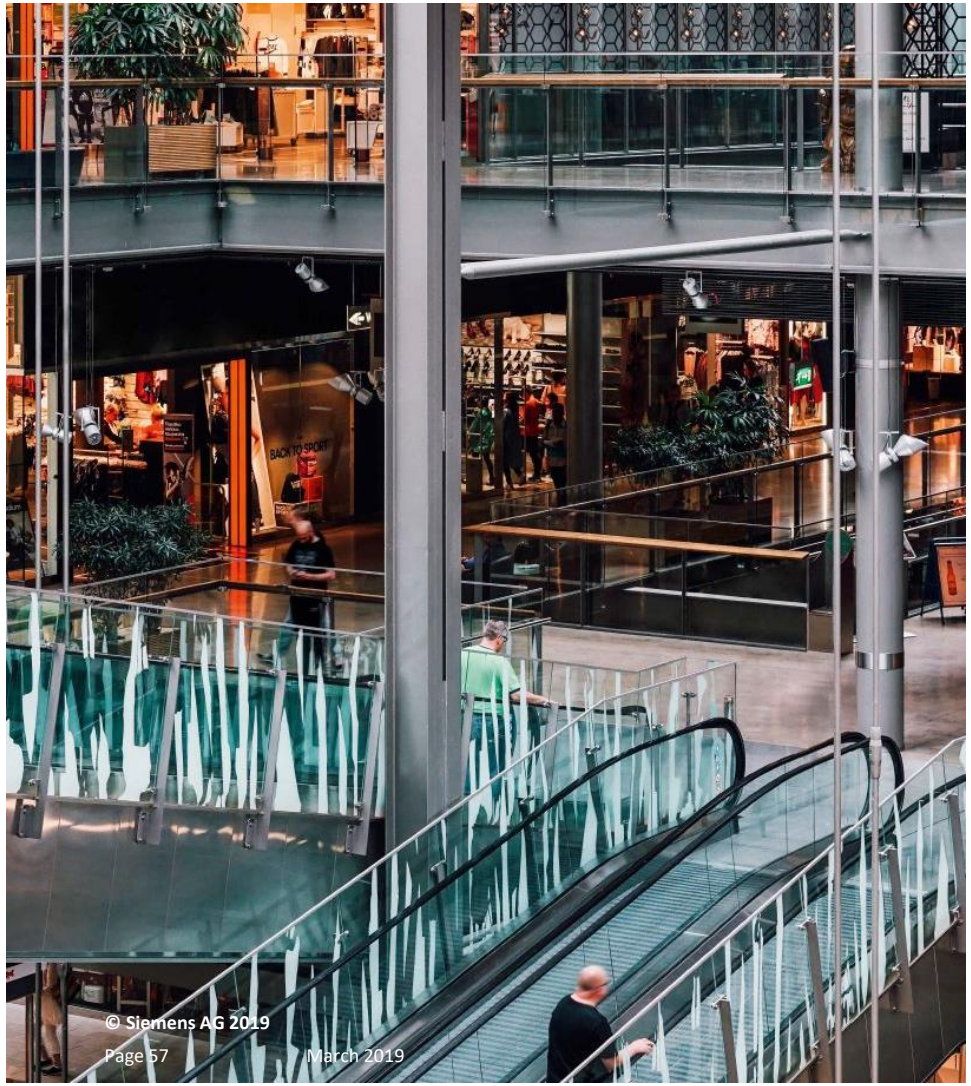
Protecting a world heritage site – Ministry of Energy, Ecuador

First of its kind local energy solution – supporting Ecuador's goal of "Zero Fossil Fuels on the Galapagos Islands".

This 1.2 MW hybrid power plant on Isabela Island is based on 100% renewables, i.e. solar power and biodiesel with a battery storage system.

Benefits

- Designed to run completely carbon-neutral
- 99% availability
- Average monthly CO_2 reduction of 80 t
- 30 dB noise reduction



Digital buildings in practice – Sello Shopping Center, Finland

Connection of 1,500 data points for error detection and diagnostics.

Cloud-based transparency and reports with dedicated operations manager.

State-of-the-art electrical engineering with e.g., energy storage integration, building automation and micro grid controller.

Benefits

- 50% reduction in district heating
- €118,000 per year energy cost savings
- 281 fewer tons of CO_2/a in emissions

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Thank you

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